Unwired Response to ACA on Proposals for 5GHz Spectrum Arrangements

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1. Introduction

This paper has been prepared by Unwired Australia Pty Ltd (Unwired) in response to the Australian Communications Authority's Discussion Paper on Proposals for Spectrum Arrangements for RLANs (Radio Local Area Networks) and FWA (Fixed Wireless Access) in the 5GHz Range Post WRC-03.

Unwired has reviewed the ACA Discussion Paper and has considered the issues surrounding ACA's proposals for the potential implementation of FWA services in the band 5250MHz to 5350MHz.

Unwired's conclusion, based on its own experience in the development of FWA services in the 3.5GHz licensed spectrum band, is that potential providers of FWA services in the 5GHz band will need to deal with serious technical and commercial restrictions. This applies in both metro and rural areas.

2. Background

Unwired Australia Pty Ltd is a wholly owned subsidiary of Unwired Group Ltd. Unwired Australia Pty Ltd, through its subsidiaries AKAL Pty Ltd and BKAL Pty Ltd have exclusive rights to between 65MHz and 100MHz of spectrum within the 3.4 – 3.5GHz band covering 95% of the population of Australia. Within Unwired's coverage area some 70% of Australian households and 75% of businesses are located in 21 cities and towns.

At the end of 2003 Unwired achieved listing on the ASX. As part of this process Unwired submitted a Prospectus for investors.

The Unwired Prospectus indicates that Unwired is seeking to implement a FWA network in the Sydney region, and that it requires an investment of $85 million to cover expected capital and operational costs.

After going to the market Unwired achieved an investment of $105 million.

Unwired is now in the process of constructing its network in Sydney. The intention is to provide indoor coverage of up to 95% of the population within the Unwired coverage area – the intention is to make use of leading edge Non Line of Sight (NLOS) FWA that allows for connection to modems that are located within customer premises at distances up to 3.5km from Unwired base stations.

To achieve this capability Unwired has chosen to make use of FWA technology from Navini, a FWA communications supplier based in Dallas, Texas.

Unwired intends to install around 70 base stations within the Sydney region. At this time Unwired is in the process of securing base station sites, and procuring all necessary equipment and services to construct and manage the network. It is Unwired's intention to be in operation during the middle of 2004.

3. Fixed Wireless Access Network Implementation

Unwired is in the process of implementing an FWA network in the Sydney region.

The design of the network and choice of supplier of access components depends on the consideration of three components, being:

- Coverage,
- Capacity, and
- Cost.

This can be boiled down to the simple value proposition…

Unwired Customer Proposition

A customer can walk into a shop, buy our "Rabbit" modem, take it home, plug it into a computer and enjoy our high speed Internet and Telephone services immediately.

The above slide shows the kind of modem that Unwired intends to use. This modem is expected to be operated in an indoor environment, located close to the customer's computer.

In the initial implementation of a network, Coverage considerations are paramount. Failure to provide Coverage means that the service will not be available to all customers and hence there will be significant commercial issues. Unwired has worked to a specification of 95% coverage of the population within the intended supply area, with base stations operating with a radius of more than 3km wherever terrain allows. It should be noted that Unwired has set the coverage requirement on the basis of providing services to customers located indoors – the intention is to provide service to modems that have not required special installation.

Once Coverage has been achieved the next requirement is Capacity. The requirement here is that it be possible to provide services to customers that are in high density areas without impacting on existing coverage. Unwired's requirements here have been that it be simple to expand the capacity of its network without major investment and rework. Generally this requires that any supplier of FWA equipment has a simple capacity expansion mechanism that is cost effective and non-disruptive.

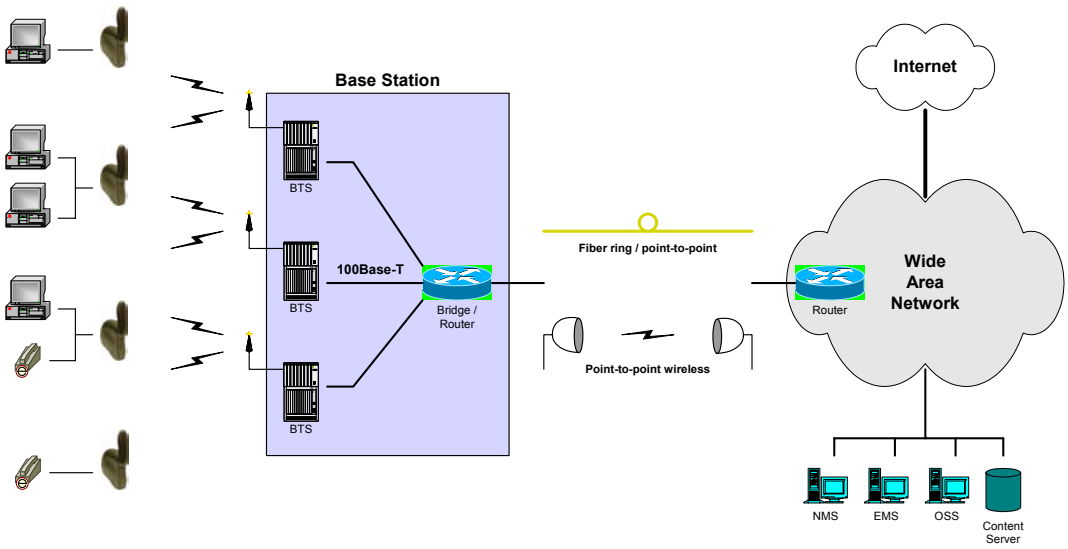
The final requirement of Cost depends on the effectiveness of Coverage and Capacity, along with the simple requirement that any network implementation and operation be inexpensive compared to alternative access technologies.

Unwired has chosen to take advantage of FWA technology supplied by Navini Networks, a Richardson, TX based company devoted to the provision of leading edge solutions. In 2003 Unwired had undertaken a detailed review of available technologies and had come to the conclusion that Navini best satisfied the above components.

An important point of comparison is the System Gain that an FWA supplier can support. System Gain is defined as the ratio of the eirp (equivalent isotropic radiated power) of the base station and the receive power at the antenna of the modem. Unwired had concluded that an FWA supplier would need to support a System Gain of more than 160dB (deciBels) to achieve Unwired Coverage requirements. Navini technology has been able to demonstrate a System Gain that well exceeds this level. In addition Navini technology can offer a simple expansion path, meeting Capacity considerations too.

The following diagram shows how Unwired intends to implement its network in the Sydney region.

Network Configuration



While researching our response to the ACA Discussion Paper, it was noted that in Rec ITU-R F.1613 a definition of Fixed Wireless Access appeared to be based on less than contemporary capabilities. In Annex 1, Section 3 of the Recommendation there is a description of technical features of FWA systems. For example there is an assumption that only one station within a cell will be operating at any instant in time – this is not the case of the Navini implementation

chosen by Unwired, and it is certain that other providers do not match this assumption. Additionally there is an assumption that remote stations (modems) have antenna gains of 15dBi which is consistent with a professionally installed external antenna at a customer premises. In the case of Unwired the Navini modems have antenna gains well below the 15dBi assumed by the ITU.

Unwired notes that these differences may impact on some of the conclusions reached by the ITU in considering interference, especially into Earth exploration satellite services and space research services that share the same band.

Additionally Unwired notes that an ITU expectation that FWA operators constrain themselves to external antennas at customer premises is too restrictive – this would require professional installation of services and thus would lead to heavy up front costs prior to offering services to customers.

4. Consideration of FWA in the 5GHz Environment

The intention of this section is to explore the issues surrounding the implementation of an FWA based service, making use of capacity within the 5GHz spectrum.

The discussion is split into two parts, where we consider firstly how FWA may operate in a "clean environment" then secondly consider the impacts of restrictions that would need to be placed on FWA operations in a "real world environment".

4.1 Clean Environment Considerations

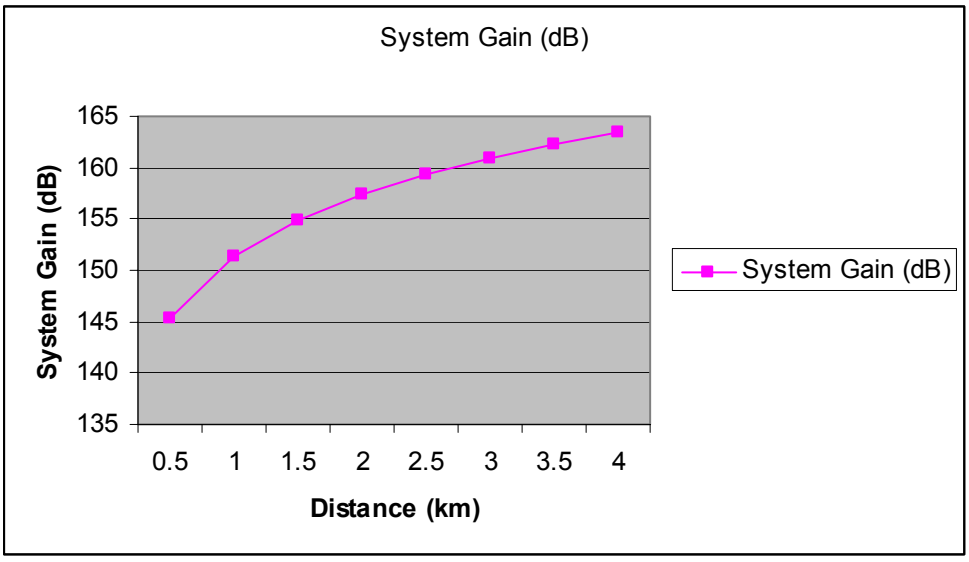
4.1.1 Coverage in a Clean Environment

In the 3.5GHz spectrum, Unwired has concluded that a System Gain in excess of 160dB is needed to support Non Line of Sight Services. This figure was determined by considering the summed effects of Free Space Path Loss, Clutter Losses and Penetration Losses.

To clarify, Clutter Losses are the losses that result in placing a modem in a local environment, where objects, bodies and other nearby obstructions can impact on the signal being sent to a receiver. Penetration Losses are those losses that come about from radio signals reaching a modem that is located indoors – this involves either a radio signal penetrating a wall or walls, or leaking into a building via windows or other apertures to reach an indoor modem.

At 5GHz Free Space losses are greater over a specific distance, and it is expected that Clutter Losses will be greater too. To confirm this, testing and measurements would need to be taken in a series of clutter environments. In the case of Penetration Losses, at 5GHz it is expected that the predominant method of accessing indoor modems would be via leakage, rather than penetration. This ties in with Unwired's experience in the 3.5GHz band.

For the purposes of a "real world" analysis, we have assumed that Clutter Losses are on an average around 25dB, and that Penetration Losses are around 20dB. If we take into account a nominal Free Space Loss for a range of distances from a Base Station, then we can assess the expected losses (and hence System Gains) that would be needed for productive connection between a base station and a modem. For the purposes of this exercise we have assumed that a "Clean Environment" System Gain of 160dB would apply at 5GHz. Based on this, we assess that the effective radius of a Base Station operating at 5GHz would be limited to 2.5km.



Of course there are real world limitations that need to be considered in this analysis, being limitations on eirp (from both the base station and the remote modem), the type of modulation being used (the above example assumes the use of QPSK modulation) and the impact of noise floors (noise contribution of amplifiers and any other environmental noise that cannot be controlled).

4.1.2 Capacity in a Clean Environment

The capacity of an FWA network can be increased by several means. Examples are:

- Making appropriate use of modulation technologies to extract more information from a fixed bandwidth,
- Overlaying additional equipment in areas where customer density is high, and
- In cases where spectrum is limited, by the use of frequency re-use techniques.

Given that there is between 80MHz and 100MHz of capacity available, users of this capacity should not be restricted in frequency options, hence the first two options are the primary ones that should be considered.

If a more efficient modulation technique is employed then the signal to noise requirements of the system become more stringent. The use of QAM64 (as an example) would reduce the system gain by around 13dB, and in this case would effectively reduce the coverage area to around 1km if it is assumed that the network is set up to provide coverage to modems located indoors.

Again, in a “real world” environment, there would be other limitations brought about by eirp limitations (especially if base stations are overlaid into the coverage area), and potentially availability of bandwidth.

4.1.3 Cost in a Clean Environment

Coverage requirements set the minimum number of base stations needed to provide services to an area, and Capacity considerations then set the number of base stations needed to meet customer density needs in the same area. The network is at its least efficient when being built for coverage needs as fixed costs need to be allocated across the minimum number of base stations.

From a FWA provider perspective the need is to provide a network that can be cost competitive with other access network providers, while matching or exceeding service features offered by others.

In the 5GHz band environment, there are a number of cost factors that can impact on the competitiveness of an FWA solution. These factors include:

- The number of base stations needed to provide coverage,
- The type of CPE to be used – external CPE will have an installation cost associated with it, while indoor CPE increases base station numbers and costs,
- CPE supply costs,
- Customer and network operation costs, etc.

In the 5GHz band the base station density will be greater than other lower frequency bands hence it is expected that the cost of implementation and operation of a 5GHz FWA network will be higher than other FWA competitors.

4.2 Consideration of 5GHz Operational Restraints

The Discussion Paper considers a number of environmental restraints that need to be applied to FWA services operated in the 5250 – 5350MHz band.

These restrictions include:

- ***Reduced eirp to 3dW/20MHz.*** This is substantially lower than eirps that can be achieved in other bands, and hence has a direct impact on the available system gain. If we assume that the impact is in the region of 15dB (say) then the effective radius of an FWA cell would be reduced to around 1km if a service like that being implemented by Unwired was to be considered. This means that a more conventional solution involving fixed outdoor antennas would need to be used to provide services over any distance, and even then the customer antennas may need to be placed above the local clutter.
- ***A restriction to 23 FWA base stations per area of 220 square km.*** This comes from ITU Recommendation Rec. ITU-R F.1613 that requires that FWA services in the 5GHz band not interfere into Earth Exploration Satellites and Space Research Satellites. The base station density assessment comes from a requirement that the total eirp within a satellite footprint be less than -7.6dBW/20MHz at the Earth's Surface, while the footprint is around 220 square km. This restriction corresponds to an average cell radius of 1.75km – this impacts on Coverage. The total eirp restriction also means that there is no opportunity to provide overlay services across a wide region, hence Capacity considerations are impacted too.
- ***Potential requirements to not interfere into Radiolocation services.*** The Discussion Paper notes that there is no specific requirement to limit interference – Unwired agrees that this is most likely an oversight in the current regime that will need to be addressed if FWA services are allowed to be operated in the 5GHz band. It is expected that Transmit Power Control and Dynamic Frequency Selection schemes would need to be introduced to restrict such interference – this would be a significant additional complexity for suppliers of FWA equipment in this band. The requirement to operate with DFS imposes a severe limitation on the types of services that can be offered because DFS introduces significant additional latency that adversely impacts on the Quality of Service (QoS) for voice and other streaming data services
- ***Potential requirements to operate in the same band as RLAN services.*** The additional possibility for mutual interference, especially if an FWA indoor modem solution is pursued, would impact on any service levels that could be offered by an FWA provider.

FWA services have the potential to provide broadband access to customers in rural areas – places where conventional broadband services are unable to provide access. An FWA implementation in the 5GHz portion of the spectrum is not likely to provide a suitable alternative as the path length may be up to 20km. Even if an external fixed antenna is used at the customer premises, and it is placed well above or away from local clutter, Free Space Path Losses over longer distances would still make such a service technically marginal.

5 Competition Issues

It is understood that the ACA would aim to increase the level of competition in the provision of access services. In addition there is a clear opportunity for the ACA to pursue a Spectrum Licensing process.

It is noted that the Australian Competition and Consumer Commission, and even on occasion the Productivity Commission, have acknowledged in the telecommunications industry that the ability to achieve a reasonable rate of return on any capital expenditure, particularly for infrastructure that may provide facilities based competition to incumbents, is fundamental to commercial viability. This is particularly important in an era when financial institutions are loathe to provide capital for telco infrastructure builds because of earlier over-investment in unproductive assets.

The release of additional spectrum for FWA services will have an impact on other access providers. At this time there are access providers seeking funds for construction of networks – these funds being in addition to original Spectrum Licence fees already paid. The concern here is that within the Australian market the entry of another FWA provider can increase pressure for funding among a limited number of investors. In the worst case this could lead to FWA providers being unable to compete effectively, especially against any incumbent access providers.

Assuming that it is determined that FWA services can be allowed to operate in the band 5250 to 5350MHz it is Unwired's view that the likely value of any Spectrum License may be limited by the number of technical drawbacks associated with this band.

6. Unwired Response to ACA Proposals

Below are Unwired's responses to the proposals offered by ACA in Section 10 of the Discussion Paper.

By way of initial comment Unwired notes that the basic thrust of the WRC deliberations for all portions of the 5 GHz band was RLAN and mobile use rather than FWA and that the FWA aspect was promoted by only a very small number of administrations. It is clear from the WRC outcome that outdoor and FWA use can only be accommodated by placing significant regulatory and operational constraints on the FWA service in the 5 GHz band.

6.1 Proposal 10.1: 5150 to 5250 MHz

Unwired notes the ACA Proposal and has no further comment.

6.2 Proposal 10.2: 5250 to 5350 MHz

Unwired has the greatest interest in the ACA proposals covering this portion of the 5GHz band, and has a number of comments to offer.

6.2.1 Proposal 10.2 a)

While an RLAN Base Station could be located indoors, any number of CPE may be located outdoors. The transmit power of these CPE, especially added together could represent a significant chance of causing interference into an FWA system, and an FWA system could interfere into these devices.

Unfortunately there is no definition of "indoor" – there have been attempts to define this term in a number of Determinations, however these definitions have been difficult to administer.

Given this, Unwired is of the view that attempting to set parameters or obligations around "predominantly indoor" would lead to complications that would be difficult to administer or police.

6.2.2 Proposal 10.2 b)

Unwired has no specific view on this Proposal. Unwired notes that there may be significant growth in the number of RLANs in operation by 1 January 2006, and hence the potential for interference into Radiolocation services may be greatly increased.

6.2.3 Proposal 10.2 c)

As noted in this Submission, Unwired is of the view that FWA services in this band are likely to be difficult to operate, even if RLAN operations are removed from this band. Given this, Unwired believes that ACA should need to remove RLAN services from this band if any FWA implementation is to be considered. Unwired shares the view of the ACA that clearance of class licensed devices from this band is likely to be very difficult.

6.2.4 Proposal 10.2 d)

Unwired has no input to make on this Proposal.

6.2.5 Proposal 10.2 e)

Given Unwired's view that there are significant environmental considerations surrounding the operation of FWA services in this band due to Satellite and potentially Radiolocation services, the addition of potential interference from RLANs would increase the complexity of offering FWA services. It is noted that the ITU has a view on the set up of an FWA network, based on the information in Rec ITU-R F.1613 does not necessarily align with contemporary practice. If FWA modems are indoors then the chance of interference from "predominantly indoor" RLANs would be increased.

6.2.6 Proposal 10.2 f)

In the case where an FWA network is operating within the same geographic area or portion of spectrum as the Radiolocation service, Transmit Power Control and Dynamic Frequency Selection requirements would need to be met. This would be a complex additional requirement that would need to be added to FWA equipment, and FWA equipment suppliers may not be able to provide this capability. Unwired's view is that the simplest approach be to make use of band segmentation as the best means of protection of Radiolocation services.

6.3 Proposal 10.3

Unwired notes the ACA Proposal and has no further comment to make.

6.4 Proposal 10.4

Unwired notes the ACA Proposal and has no further comment to make.

7 Conclusions

The view reached by Unwired is that the implementation of FWA services in the 5GHz Band, especially FWA services that have capability to provide connectivity to modems placed at indoor locations, will be problematical.

This is especially so when the environmental constraints of the impact of interference with Earth Resources Satellites, Radiolocation services and existing RLANs are taken into account.

Unwired's view on proposals to introduce FWA services into the band 5250MHz to 5350MHz is that the spectrum is not likely to be seen to be of value by potential FWA players.